of a mast-mounted low-noise amplifier (LNA). Currently, several manufacturers sell LNAs."[66]

The gain achievable with an LNA is more than sufficient to ensure the adequacy of the digital signal intensity standards in fringe areas.[67] For example, the pre-amplifier the UHF Comparability Task Force used in one study, which was chosen because of its good performance characteristics and relatively low price, possessed a gain of 16 dB and an internal noise figure of 3.7 dB, for an aggregate advantage of 12.3 dB.[68] The Electronics Technicians Association stated in CS Docket No. 98-201 that typical gains with current pre-amplifiers are 17 dB to 24 dB.[69]

Current offerings of LNAs from several manufacturers are compiled in Exhibit 2. For instance, Winegard currently offers 16 different LNAs with gains ranging from 17 dB to 29 dB. One of their LNAs, Model AP-8275, provides an average gain of 29 dB for VHF and 28 dB for UHF with an internal noise figure of only 2.9 dB and 2.8 dB in those respective bands.[70] Channel Master offers an LNA, Model 7777, with an average gain of 23 dB for VHF and 26 dB for UHF with an internal noise figure of 2.8 dB for VHF and only 2.0 dB for UHF.[71] Antennacraft offers an LNA with adjustable gain to prevent receiver overload. This model, Model 10G212, provides an average gain

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[66] *ATSC Technology Group Report: DTV Signal Reception and Processing Considerations*, Doc. T3-600r4 (Sept. 18, 2003), at 37.

[67] *Cf. Technical Standards for Determining Eligibility for Satellite-Delivered Network Signals Pursuant to the Satellite Home Viewer Improvement Act*, Report, 15 FCC Rcd 24321 (2000), at ¶ 32 (stating that, "where needed, the combination of a smaller low gain antenna and an inexpensive low noise amplifier at the antenna terminals can easily provide an effective gain equal to the planning factor values").

[68] *See UHF Comparability Final Report* at 75 n.18, 76 (Table 3-10 n.3).

[69] *See* Electronics Technicians Association Comments, CS Docket No. 98-201, at 14-15.

[70] *See* Exhibit 2. Winegard's AP-8275 LNA retails for $77.99 from Solid Signal (solidsignal.com).

[71] The Channel Master 7777 LNA retails for $56.99 from Solid Signal (solidsignal.com).

of 30 dB for both VHF and UHF with a noise figure of less than 4.0 dB for VHF and less than 3.5 dB for UHF. This model's list price is only $33.63 (antennacraft-tpd.com).[72]

Specialty LNAs are also available from manufacturers such as Blonder Tongue and Advanced Receiver Research. Advanced Receiver Research manufactures single channel LNAs with exceptionally low noise figures. For example, single channel low VHF LNAs are available with a gain of 24 dB and a noise figure of only 0.5 dB. Advanced Receiver Research also manufactures a broadband UHF LNA with narrow tune capability with a gain of 15 dB and a noise figure of 0.6 dB.[73] Blonder Tongue not only makes single channel LNAs, but it makes broadband LNAs with exceptionally high gain figures. For instance, Blonder Tongue's Vaulter III Plus model provides a gain of 31 dB in the VHF band and a gain of 38 dB in the UHF band with a noise figure of 4.5 dB across all bands.[74]

In addition to LNAs, the Commission has always expected and recognized that

> persons living in areas located in the outer reaches of the service areas of broadcast stations (for example, at the edge of a predicted Grade B contour) can, and generally do, take relatively simple measures such as installation of an improved roof-top antenna and careful location and orientation of that antenna to enhance their off-the-air reception.[75]

In fact, the Commission expressly advised that "[a]ntennas should be installed by 'probing' for the best receiving location; signal strength can vary significantly over a very short distance; thus, the

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[72] *See* Exhibit 2.

[73] *See* Exhibit 2. Prices for these specialty LNAs from Advanced Receiver Research are not available online, but comparable models for other applications appear to list for approximately $80 and up (advancedreceiver.com).

[74] *See* Exhibit 2. The Blonder Tongue Vaulter III Plus LNA retails for $99.99 from Solid Signal (solidsignal.com).

[75] *Cable Communications Policy Act Rules*, Second Report and Order, FCC 88-128, 64 Rad. Reg. 2d (P & F) 1276 (1988), ¶ 18.

antenna should be installed at the location that provides good picture quality for the channels desired."[76]

As the Electronics Technicians Association showed in CS Docket No. 98-201, the majority of home antenna systems in Putnam County, Indiana, a location representative of the outer reaches of the service areas of broadcast stations, contain a rotor (in addition to an LNA)—and this is true, as the Electronics Technicians Association further remarked, even though homeowners in Putnam County can receive network programming from each of the four major networks from affiliates all located in Indianapolis.[77]

In fact, as the Electronics Technicians Association correctly pointed out:

> Rotors are as important in many areas as steering wheels are in automobiles. Because a household needs to reverse the antenna to get a signal 180 degrees from another should not be an excuse to pay $600 over ten years to receive the signal via satellite instead of installing the proper antenna system.[78]
>
> Rotors are economical ($60-$75) and they do not require constant rotation. . . . To circumvent the intent of the SHVA because the homeowner prefers to not invest in a rotor where needed[] is not right.[79]

Channel Master, Antennacraft, and Radio Shack each sell rotors for home antenna installations. Some of these rotors are available with a remote control so the viewer can properly orient the antenna from the couch. A sample of such rotors is compiled in Exhibit 3. Prices for rotors range from $68.99 for the Channel Master with remote control (available from Solid Signal

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[76] Improvements to UHF Television Reception, *Report and Order*, 90 F.C.C.2d 1121 (1982), ¶ 50.

[77] Electronics Technicians Association Comments, CS Docket No. 98-201, at 6.

[78] *Id.* at 21

[79] *Id.* at 24.

(solidsignal.com)) to a list price of $94.88 for the Antennacraft (antennacraft-tpd.com), with the Radio Shack rotor priced in the middle (radioshack.com).

System Noise Figure. It is difficult to obtain data from receiver manufacturers on the specifications, including noise figure, of DTV receivers, and, thus, it is difficult to verify that the assumed noise figures in the DTV planning factors are accurate. However, it has long been recognized that the *system* noise figure is essentially determined by the noise figure of an LNA if the system incorporates such an amplifier, which, as shown above, is standard for fringe reception areas.[80] In fact, not long after the original Grade B planning factors were established for analog broadcasting, it was recognized that the system noise figure could be reduced by as much as 6 dB if an LNA were incorporated into the reception system.[81]

When an LNA is combined with a DTV receiver in a system, the noise figure (NF) of the system is given by the following[82]:

$$NF_{system} = 10 \log_{10} [NF_{LNA} + (NF_{receiver} - 1)/Gain_{LNA}]$$

Thus, when the noise figures of readily available consumer LNAs are considered, it is plain that system noise figures on the order of 3 to 4 dB, far below the assumed system noise figures of 10 dB,

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[80] *See UHF Comparability Final Report* at 73 ("If the preamplifier is located at the antenna, the overall amount of noise in the picture will be established by the noise characteristic of the preamplifier . . . .").

[81] *See* Robert A. O'Connor, *Understanding Television's Grade A and Grade B Service Contours*, BC-14 IEEE TRANS. ON BROADCASTING 137, 142 (Dec. 1968) ("[M]ost receivers now have noise figures considerably better than indicated. This is particularly true in the outlying areas where the use of low-noise, moderate-gain antenna-mounted preamplifiers can reduce these figures by as much as 6 dB.").

[82] *See Technical Standards for Determining Eligibility for Satellite-Delivered Network Signals Pursuant to the Satellite Home Viewer Improvement Act*, Report, 15 FCC Rcd 24321 (2000), at ¶ 32 n.115.

10 dB, and 7 dB for the low VHF, high VHF, and UHF bands, respectively, are easily achievable in conventional home reception installations. There is, accordingly, no question that the Commission's DTV planning factor for system noise figure can be considered conservative when viewed in the context of a complete reception system.

Miscellaneous Considerations. Several other considerations are relevant to the adequacy of the Commission's DTV planning factors for real-world reception of DTV signals. Perhaps most importantly, in the early stages of the DTV transition, multipath was known to be more difficult for digital reception than it is for analog reception. In fact, the International Telecommunications Union specifically incorporated an additional cushion into the carrier-to-noise ratio it assumed for its ATSC DTV planning criteria to account for typical multipath reception impairment, making the cushioned C/N ratio 19.5 dB.[83] Fifth generation DTV receivers, which are now commercially available in integrated sets from manufacturers such as LG and Zenith, have made substantial improvements in equalizer architecture and can now handle 50 microsecond pre-ghosts and 50 microsecond post-ghosts.[84] As one recent report summarizes the current state-of-the-art:

> Because of the "all or nothing" nature of digital reception, digital TV must provide excellent reception even where analog reception is poor, in order to facilitate the transition for the large number of receivers that use over-the-air reception. *This is beyond the requirements originally proposed at the inception of digital television, but it is*

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[83] *See, e.g.*, International Telecommunications Union, *Draft Revision of Recommendation ITU-R BT.1368-4*, Document 6/BL/32-E (Mar. 22, 2005), at Table 13 and note 1 to table.

[84] *See* Tim Laud *et al.*, *Performance of 5th Generation 8-VSB Receivers*, 50 IEEE TRANS. ON CONSUMER ELECS. 1076 (Nov. 2004); Communications Research Centre Canada, *Results of the Laboratory Evaluation of Zenith 5th Generation VSB Television Receiver for Terrestrial Broadcasting* (Sept. 2003).

being met by 5th generation designs.[85]

Because multipath is not a function of signal strength *per se* and because current fifth generation receivers can handle multipath even in generally poor reception conditions, the Commission's DTV planning factors do not need to be adjusted to account for multipath the way in which the ITU recommended.

In addition, because so few earlier generation DTV receivers are owned by consumers—estimated at no more than 1% penetration[86]—it is clear that virtually all household sets

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[85] *Performance of 5th Generation 8-VSB Receivers* at 1080 (emphasis added).

[86] It is difficult to obtain complete DTV receiver penetration information. In January 2004, in the *Tenth Annual Video Competition Report*, the Commission observed (i) that "[w]hile over 1000 stations are providing a DTV signal, many consumers within those service areas are unable to view the DTV format either because they do not have DTV receivers or because they are subscribers to a MVPD that does not carry the DTV signal," and (ii) that "[f]rom their introduction in August 1998 through the second quarter of 2003, over six million HDTV-capable sets have been sold, but only 700,000 of these [i.e., 11.67%] have been purchased with a built-in tuner or add-on decoder box required for receiving an HDTV broadcast." *Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, Tenth Annual Report, FCC 04-5 (released Jan. 28, 2004), ¶ 96 n.433 & ¶ 103. Updating that data through December 2003, as reported by the Consumer Electronics Association, indicates that approximately 8.88 million DTV units were sold from 1998 through December 2003. *See Holiday Sales Boost DTV Numbers for October and November* (Dec. 18, 2003), *available at* http://www.ce.org/press_room/press_release_detail.asp?id=10375 (stating that the "total number of DTV products sold since introduction in the fourth quarter of 1998 is now 8.24 million units"); *2003 a Banner Year for DTV; Unit Sales Top Four Million* (Jan. 12, 2004), *available at* http://www.ce.org/press_room/press_release_detail.asp?id=10396 (stating that "December 2003 sales totaled 640,443"). That number, of course, represents DTV-*capable* units and necessarily includes sales of units to restaurants, sports bars, and other public venues vis-à-vis private households; the number of DTV *receivers* in actual homes, as the Commission has observed, is far less. Considering that there were more than 108 million television households in the 2003-2004 television season, according to Nielsen Media Research, it is clear that DTV receiver penetration did not reach even 1% by the end of 2003 (((700,000 ÷ 6,000,000) × 8,880,443) ÷ 108,410,160 = 0.96%). Network Affiliates recognize that this calculation does not include sales figures for 2004, but CEA appears not to have separately reported those figures for DTV receivers, and the Commission's *Eleventh Annual Video Competition Report* makes no mention of them either. *Cf. Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, Eleventh Annual Report, FCC 05-13 (released Feb. 4, 2005), ¶ 87 (similar figures (continued...)

do or will contain late generation receiver chips, especially given the effective dates of the Commission's tuner mandates. Indeed, given SHVERA's time table to implement the digital signal site testing regime, it is likely that sixth generation receivers with additional improvements will be commercially available by then. This obviates the need for the Commission to consider whether to artificially boost the digital signal strength thresholds to account for multipath.

It is also worth comparing several of the other assumptions made by the ITU in its ATSC digital planning criteria with those assumed by the Commission. For example, the ITU assumed an antenna gain of 8.2 dB for low VHF, 10.2 dB for high VHF, and 12.2 for UHF.[87] Each of these exceed the antenna gains assumed by the Commission in the DTV planning factors, but, as the Network Affiliates' survey of commercially available antennas demonstrates, each of the ITU's antenna gain assumptions are readily achievable by real-world antennas available for purchase today. In addition, the ITU assumed transmission line loss of 1.1 dB for low VHF, 1.9 dB for high VHF, and 3.3 dB for UHF.[88] The VHF line loss values are virtually identical to those assumed by the Commission, while the UHF line loss value is less. As the specifications for RG-6 coax cable indicate, even the ITU's assumptions remain slightly conservative. Finally, for receiver noise figure, the ITU assumed 5 dB for both low VHF and high VHF and 10 dB for UHF.[89] These assumed noise

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[86](...continued)
as in *Tenth Annual Video Competition Report* not provided). DTV receiver penetration did undoubtedly increase in 2004, but the imbedded base of DTV receivers is still low, and, more importantly, any DTV receivers sold in 2004 would have contained later generation chips (fourth or fifth generation), which only underscores the point that there are very few early generation DTV receivers in consumers' hands.

[87] *See Draft Revision of Recommendation ITU-R BT.1368-4* at Table 13.

[88] *See Draft Revision of Recommendation ITU-R BT.1368-4* at Table 13.

[89] *See Draft Revision of Recommendation ITU-R BT.1368-4* at Table 13.

figures for VHF are substantially less than—indeed, they are half—what the Commission assumed, while the ITU's UHF noise figure is higher. In any event, each of these noise figures is higher than the system noise figure would be if it incorporated an LNA. The ITU makes additional assumptions that the Commission did not (including incorporating an LNA and an antenna balun, among others), but the end result is signal strength levels generally in line with the Commission's own, 35 dBu for low VHF, 33 dBu for high VHF, and 39 dBu for UHF. What the ITU's independent results do is corroborate that the Commission's 1997 DTV planning factors led to signal strength thresholds that are realistic for real-world reception conditions for a typical receiving installation located near the edge of coverage and for a viewer taking reasonable steps, including an outdoor antenna oriented or orientable to the desired signal and an appropriate receiver, to receive DTV service.

* * *

Based on the above survey of considerations affecting the Commission's DTV planning factors, it is possible to adjust the DTV planning factors to account for what is possible under current real-world *reception* conditions—not NTSC replication conditions. Such adjustments would recognize the minor alteration in the dipole factor for UHF, a slight reduction in downlead line loss for UHF, slightly better receiving antenna gains from readily available outdoor antennas, lesser noise figures in all bands through use of an LNA (without even accounting for the additional gain to the receiving installation from the amplification provided by the LNA), and the ability of fifth generation DTV receivers to perform well when confronted with substantial pre- and post-ghosts. The results of these minor adjustments are shown in Table 2.

***Adjusted* DTV Planning Factors** *Table 2*

Parameter	Channels 2 to 6	Channels 7 to 13	Channels 14 to 69
Thermal Noise	(106.2)	(106.2)	(106.2)
Dipole Factor	111.8	120.8	130.2
System Noise Figure	4	4	4
Downlead Line Loss	1	2	3
Receiving Antenna Gain	(6)	(10)	(12)
Carrier-to-Noise Ratio	15.2	15.2	15.2
Median Field Intensity	19.8 dBu	25.8 dBu	34.2 dBu

Network Affiliates do not recommend that the Commission actually propose to Congress these adjusted planning factors as the basis for digital signal strength thresholds for site testing purposes. Rather, what these adjusted planning factors show is that the current planning factors, in a proper receive installation, have plenty of "headroom"—a "safety margin," as the Commission has termed it[90]—to ensure that quality DTV reception is achievable precisely where the Commission expected it to be—in the replicated NTSC coverage area where 50% of the viewers would be able to receive acceptable service 90% of the time. In fact, that "headroom" or "safety margin" ensures that substantially more than 50% of the viewers are able to receive acceptable service 90% of the time or, equivalently, that 50% of the viewers are able to receive acceptable service substantially in excess of 90% of the time.[91] This level of coverage is more than the Commission ever anticipated in adopting the DTV planning factors, and it clearly demonstrates that the Commission need not

[90] *Technical Standards for Determining Eligibility for Satellite-Delivered Network Signals Pursuant to the Satellite Home Viewer Improvement Act*, Report, 15 FCC Rcd 24321 (2000), at ¶ 68.

[91] In addition, the "headroom" may be thought of as providing a margin of safety for any "slippage" in the receive system, such as, for example, a minor loss of signal strength due to an impedance mismatch.

recommend artificially boosting the planning factors for SHVERA purposes, which would be contrary to the limited purpose of SHVERA's ever narrower distant signal license.

The discussion of the adequacy of the DTV planning factors, the specifications and characteristics of currently available consumer equipment, and the Commission's intentions and expectations in promulgating the DTV planning factors, together with Congress's long history of minimizing the abrogation of the rights of copyright holders and of preserving and promoting localism and the network-affiliate distribution system and with the nature of the particularly limited—and now even narrower—regime for the satellite delivery of duplicating distant digital network signals, all appropriately drive consideration of the inquiries required by SHVERA and set forth in the *Notice*. All of these considerations point ineluctably to the following conclusions:

First, the receiving antenna must be mounted outside on the roof or adjacent to the house. Moreover, the antenna must be oriented to the desired signal, and if the desired stations are not located in the same direction, then the antenna must be orientable in the direction of the desired signal(s).[92] In addition to all of the above considerations which point to this natural conclusion, it is worth observing that satellite receive antennas are mounted outside and are oriented to the satellite. It would be inappropriate to essentially penalize a local television station for a consumer who was only willing to install an indoor antenna or an antenna that was not capable of being oriented to the desired signal, especially when the consumer is willing to take additional, necessary steps to obtain adequate satellite reception. Consequently, there is no need for the Commission to consider modifying the inherent assumptions regarding DTV antenna receiving systems in the DTV

[92] *See Notice* at ¶ 9.

planning factors.[93] An excellent antenna receiving system can be installed at relatively low cost. For example, the Channel Master Model 4228 eight-way bowtie-with-screen antenna, which even has adequate gain at VHF frequencies, costs only $39, and it can be paired with the Channel Master rotor with remote control for $69, for a complete system price of only $108. If additional gain were necessary or there were a desire or need to lower the system noise figure, the Antennacraft Model 10G212 LNA with adjustable gain can be added to the receive installation for an additional $33.63.

Second, the Commission should continue to recommend that the current signal strength thresholds for noise-limited digital service should be used to define the availability of a DTV signal for determining whether a household is eligible to receive distant digital signals from satellite services.[94] As stated above, real-world equipment, including fifth generation receivers, demonstrates that the Commission's current signal strength thresholds are more than adequate to receive a high-quality digital picture. There is no basis to artificially boost the current signal strength thresholds. And there is certainly no basis to retreat from a signal strength standard altogether when that can only jeopardize localism and the network-affiliate distribution system while running counter to the extremely narrow compulsory license that remains in SHVERA for satellite delivery of duplicating distant network signals.

Third, variation in DTV set prices should play no role in determining whether a household is unserved by an adequate DTV network signal.[95] The evidence shows that there is very little penetration (no more than 1%) of early generation DTV receivers in television households. Most

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[93] *See Notice* at ¶ 11.

[94] *See Notice* at ¶ 14.

[95] *See Notice* at ¶ 16.

households have or will acquire DTV sets with integrated tuners incorporating the latest generational chip design (fifth generation or later), including equalizers demonstrating superior multipath handling performance capabilities. With digital tuners manufactured in mass quantities to satisfy the Commission's tuner mandate, the cost of an integrated DTV set is not particularly dependent on the cost of the generation of chip design (say, fourth generation versus fifth generation). Instead, DTV set prices are largely dependent on features, such as ATSC format capabilities (enhanced definition versus high definition, particularly in smaller-sized models), screen size, screen technology (CRT, plasma, LCD, DLP), screen resolution, contrast ratio, and integration of other functions, such as digital video recorders ("DVRs"). For example, a survey of the Sharp Aquos and LG websites revealed no difference in the type of ATSC tuner included in integrated DTV sets within each manufacturer's product lines. It would make a mockery of the principle of localism, and of the objective standards Congress has always imposed on the "unserved household" definition, to permit a satellite carrier to deliver a duplicating distant network signal to a household merely because the household had purchased, probably unknowingly, an inferior quality DTV set. The current analog "unserved household" definition is not dependent on whether a household buys a $59 13-inch television set or a $400 27-inch television set. There is no reasonable, defensible basis to make such a distinction in the digital context. Moreover, there is no workable basis to incorporate a receiver quality factor into a site testing regime, given the many dozens, if not hundreds, of consumer DTV sets available for purchase in the market. Finally, as the *Notice* appears to recognize,[96] any limitations in fifth generation receiver design are likely to be highly mitigated by using higher performance antennas with high front-to-back ratios and auxiliary devices such as rotors and LNAs.

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[96] *See Notice* at ¶ 17.

Fourth, multipath should not be taken into account in determining whether a household is served by an adequate digital signal.[97] As shown above, fifth generation receivers incorporate equalizers that are remarkably good at handling very early pre-ghosts and very late post-ghosts (on the order of 50 microseconds each). But, more fundamentally, multipath is not a matter of signal strength, which is the objective means by which a digital "unserved household" should be determined. The effects of multipath, however, can be greatly, if not wholly, mitigated by the use of the latest generation receiver; by the use of an outdoor antenna raised to 30 feet which will place the antenna far above the principal multipath reflectors, including moving vehicles such as cars, trucks, and buses, as well as neighboring houses; and by the use of highly directional antennas with high front-to-back ratios, properly oriented to the strongest desired signal. As the ATSC has observed: "[A]n antenna with a directional pattern that gives only a few dB reduction in a specific multipath reflection can *dramatically* improve the equalizer's performance. Such modest directional performance can be achieved with antennas of consumer-friendly size, especially at UHF."[98] In addition, the Commission refused to include multipath within the distant analog signal eligibility standard,[99] and there is no principled basis to include multipath in the distant digital signal eligibility standard since there still remains no objective means to predict or evaluate multipath at any particular location or to evaluate the impact of multipath on local television service generally.

In sum, the only way to respect the Commission's own history of implementing the DTV

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[97] *See Notice* at ¶ 20.

[98] *ATSC Recommended Practice: Receiver Performance Guidelines*, Doc. A/74 (June 18, 2004), at 24 (emphasis added).

[99] *See Technical Standards for Determining Eligibility for Satellite-Delivered Network Signals Pursuant to the Satellite Home Viewer Improvement Act*, Report, 15 FCC Rcd 24321 (2000), at ¶ 59.

service, to respect the narrow and limited purpose of the distant signal compulsory license, and to respect the bedrock principle of localism in television service is for the Commission to recommend to Congress that its existing signal strength thresholds remain the objective standards by which the eligibility of a household for duplicating distant digital signal service should be determined.

III. The Commission's Objective Test Methodology for Analog Signals Is Generally Sound but Must Be Modified Slightly to Test Objectively the Signal Strength of Digital Broadcast Signals

Section 73.686(d) of the Commission's rules sets forth the testing procedure for cluster measurements of signal strength at household locations. This methodology was developed specifically for analog signals, but it is generally workable for digital signals once several slight modifications are made to measure the signal strength of digital signals.[100]

First, a directional gain antenna should be utilized instead of a half-wave dipole. Since the objective of the site test is to determine whether adequate signal strength exists to deliver high-quality DTV reception, use of a directional gain antenna that can be oriented to the strongest desired signal and that can ameliorate any difficulties that could be caused by multipath at the site would represent a better engineering practice than use of a half-wave dipole in these circumstances.

Second, there is no visual carrier for digital signals, so the requirement in Section 73.686(d)(2)(i) to measure the visual carrier makes no sense in the digital context. The *Notice*'s suggestion to substitute the pilot signal for the visual carrier is not feasible.[101] The Commission defines digital signals by their integrated average power over the 6 MHz bandwidth. It is this integrated average power that should be measured to determine the field strength. Because

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[100] *See* Cohen Engineering Statement at 6-7.

[101] *See Notice* at ¶ 13.

the 6 MHz bandwidth of the digital channel will contain many sharp peaks and valleys and because the pilot signal, which is already down 3 dB, could fall within a valley, there is little likelihood that measurement of the pilot signal will tell one anything useful about the actual signal strength of the digital signal. Again, the field strength of a digital signal should be determined by measuring the integrated average power over the 6 MHz bandwidth.

Third, a typical analog field strength meter cannot be used to measure digital signal strength since its bandwidth is too narrow. Instead, the tester should use a spectrum analyzer tuned to the center of the channel, sweep across a variety of small intermediate frequency bandwidths, and integrate the total power across the 6 MHz bandwidth.

With these slight modifications, the testing methodology in Section 73.686(d) will permit the objective testing of the signal strength of digital signals. But this is true only if the remaining elements of the testing methodology are not altered. Most notably, the site test must measure signal strength *outdoors*, at the specified rooftop heights (20 feet for one-story residences, 30 feet for all others), and with the testing antenna properly oriented.[102] The Commission should not consider developing specific procedures for measuring signal strength indoors.[103] As explained extensively above, DTV service was designed to provide a service that would replicate existing Grade B analog service, and that existing Grade B analog service was always predicated upon providing satisfactory service to 30-foot outdoor antennas, properly oriented, located at households near the fringe of the station's service area. Local service will simply be eviscerated if the Commission were to recommend measuring signal strength indoors or establishing an indoor standard that the entire DTV

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[102] *See* 47 C.F.R. § 73.686(d)(2)(iii), (iv).

[103] *See Notice* at ¶ 13.

service was never intended to be able to meet.

Of course, the test methodology must remain objective. There is neither any basis nor any warrant for the Commission to consider altering any aspect of the test methodology that would add any element of subjectivity to the test. As one third party has explained it:

> [S]ubjective tests are only applicable for development purposes. They do not lend themselves to operational monitoring, production line testing, trouble shooting or repeatable measurements required for equipment specifications. Subjective testing is too complex and provides too much variability in results, making clear the need for an objective testing method of picture quality.[104]

Finally, *what* is to be measured is as important as *how* it is to be measured. And there are numerous circumstances in which what is to be measured is not digital signal strength but analog signal strength. As noted above, in a market, for example, where a satellite carrier does not offer local-into-local digital service but does offer local-into-local analog service, if the satellite subscriber is served over the air by the local station's analog signal, then such a subscriber may be eligible for distant digital service depending on the results of a site test measurement in conjunction with certain further conditions as to market, date, and DTV build-out status. Digital signal strength is to be measured at the site test only for those stations for which the SHVERA trigger events in 47 U.S.C. § 339(a)(2)(D)(vii) are satisfied. For all other stations, the site test must continue to measure *analog* signal strength, even though it is eligibility for a distant *digital* duplicating network signal that is in issue.

This principle is best demonstrated by an example. In local Market L, which is a top 100 market, the local ABC affiliate is Station X. Station X has received a tentative DTV service channel

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[104] Tektronix White Paper, *A Guide to Maintaining Video Quality of Service for Digital Television Programs* (Feb. 2000), at 3.

designation that is the same as its current DTV channel in the core. Station X also operates two translators T1 and T2. In an adjacent market, Market A1, which is a top 100 market, the local ABC affiliate is Station Y. Although Market A1 is a top 100 market, Station Y has received a testing waiver pursuant to 47 U.S.C. § 339(a)(2)(D)(viii) because Station Y has a side-mounted digital antenna that causes it to experience a substantial decrease in its digital signal coverage area. In another adjacent market, Market A2, which is not a top 100 market, the local ABC affiliate is Station Z. If, on July 1, 2006, a satellite subscriber located in Market L seeks to have a site test conducted to determine the subscriber's eligibility for a distant digital duplicating ABC signal, then the site test must measure the following: (1) the *digital* signal strength of Station X (because the SHVERA trigger events are satisfied for Station X, *see* 47 U.S.C. § 339(a)(2)(D)(vii)(I)(aa)), (2) the *analog* signal strength of translator stations T1 and T2 (because the trigger events for translator stations are not yet satisfied, *see* 47 U.S.C. § 339(a)(2)(D)(vii)(II)), (3) the *analog* signal strength of Station Y (because Station Y obtained a digital testing waiver for a valid reason, *see* 47 U.S.C. § 339(a)(2)(D)(viii)(IV)), and (4) the *analog* signal strength of Station Z (because the trigger events for stations that are not in the top 100 markets are not yet satisfied, *see* 47 U.S.C. § 339(a)(2)(D)(vii)(I)(bb)). Only if the location of the subscriber's household cannot receive the requisite signal strength (be it digital or analog, as stated) from *any* of these stations would the subscriber be deemed eligible to receive a distant digital signal. Therefore, even if the subscriber's location is unable to receive the requisite signal strength of Station X's digital signal, if the location can receive the requisite signal strength of Translator T1 *or* Translator T2's analog signal *or* the requisite signal strength of Station Y's analog signal *or* the requisite signal strength of Station Z's analog signal, then the subscriber is *not* eligible for a distant digital ABC signal. (It should be remembered that the subscriber in this case is not left without life-line network service. Before the

testing could even occur in this example, SHVERA requires the subscriber to be receiving local Station X's ABC programming as part of the satellite carrier's local stations package offered under the Section 122 local-into-local compulsory license.)

A testing regime implemented as described herein best comports with SHVERA and Congress's long-standing policy goals to protect and preserve localism and to retain the extremely limited character of the distant signal compulsory license.

IV. The Longley-Rice Model Is an Appropriate Predictive Model to Recommend to Congress for Future, But Not Immediate, Use

SHVERA, unlike SHVIA, does not contain a requirement that the Commission promulgate a predictive model to presumptively determine whether an individual location can receive a digital signal of a certain threshold intensity.[105] Although Congress considered requiring the development of a predictive model for digital signals,[106] in the end it did not enact such a scheme. SHVERA, therefore, contains only a requirement for objective site testing to determine the adequacy of digital signal strength, and such testing can only occur after certain future trigger dates. The Commission, accordingly, has no authority to promulgate and implement a predictive model for digital signals.[107]

SHVERA, instead, directs the Commission only to "consider whether to develop a predictive methodology for determining whether a household is unserved by an adequate digital signal under

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[105] *Compare* 47 U.S.C. § 339(c)(1) (enacted in SHVERA) *with id.*, § 339(c)(3) (enacted in SHVIA).

[106] *See* S. REP. NO. 108-427, at 8-9 (2004).

[107] *See INS v. Cardoza-Fonseca*, 480 U.S. 421, 442-43 (1987) (stating that "[f]ew principles of statutory construction are more compelling than the proposition that Congress does not intend *sub silentio* to enact statutory language that it has earlier discarded in favor of other language" (internal quotation marks and citations omitted)).

section 119(d)(10) of Title 17."[108] Network Affiliates believe that the Commission should develop and recommend a predictive model for digital signals, but only for future, and not immediate, use. By "future use," Network Affiliates mean *after* the digital transition is *complete.* Before the end of the transition, too much is unknown, the process would be too complicated, and the resulting viewer confusion could be rampant.

For example, not all stations have made elections for their final digital channel, and the spectrum repacking process is far from complete. Importantly, digital service for low power stations and translators has not yet been authorized. Because a household is considered "served" if it receives a signal from any station, be it full power, satellite, or translator, affiliated with the network in issue,[109] it is not possible to predict whether a household can receive a digital signal if the station that could be delivering the signal has not yet been authorized to broadcast in digital or the station has not yet had a reasonable opportunity to construct digital facilities. Local network affiliates, particularly those in western states that rely heavily on translators, should not be penalized by having their viewers siphoned away to distant duplicating stations solely because they are unable to provide a digital signal through no fault of their own. This is the antithesis of preserving and promoting localism and the network-affiliate distribution system as well as giving an expansive capability to a compulsory license intended to be, and that by law must be, narrowly construed.[110]

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[108] 47 U.S.C. § 339(c)(1)(B)(iv).

[109] *See* 17 U.S.C. § 119(d)(2), (3), (10).

[110] Theoretically, it would be possible to predict whether a location is served by a *digital* signal of any station that does not have a Commission-sanctioned reason for not broadcasting in full power on its final DTV channel and, if not, to then predict whether that location is served by an *analog* signal of any station that does have such a Commission-sanctioned reason, but this process quickly becomes too complicated, too unworkable, and too subject to rampant confusion. Moreover, (continued...)

Consequently, Network Affiliates urge the Commission to recommend that no predictive model be implemented until the digital transition is complete. Waiting for the completion of the digital transition will not materially prejudice the distant signal license for a number of reasons. For instance, the delay will be minimal since the transition should be complete not long after SHVERA's testing scheme is fully triggered, and, of course, a site test would always be available in such circumstances. In addition, given SHVERA's "if local, no distant" policy, the need for a predictive model as well as for site testing should be rapidly diminishing over time as satellite carriers introduce local-into-local digital service into markets. Moreover, waiting for the completion of the digital transition also appears to have been Congress's intent.[111] Finally, the distant signal license existed for many years under SHVA without a predictive model, and it can do the same in the digital context, although the time frame is expected to be much less. When the relative harms are weighed, it is plain that the harm to local affiliates by permitting a predictive model to presume lack of service before the end of the digital transition is too great to be implemented prematurely.

After the completion of the digital transition, it would be appropriate to utilize a predictive model for digital signals, and Network Affiliates urge the Commission to recommend the Longley-Rice model for use in this Section 119(d)(10) context. Not only is DTV coverage predicated upon the Longley-Rice model, as set forth in OET 69, but both the broadcast and satellite

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[110](...continued)
such a hybrid process does not appear to be what Congress intended the Commission to consider and recommend.

[111] *See* H.R. REP. NO. 108-634, at 19-20 (2004) (stating that SHVERA requires the Commission to recommend "a methodology for determining whether a particular consumer would be unserved over the air by the digital signal of a specific network as transmitted by a broadcast station *after* the broadcasters in that consumer's market have ceased to broadcast in analog because of implementation of section 309(j)(14) of the Communications Act" (emphasis added)).

industries have five years of experience with the modified Individual Location Longley-Rice ("ILLR") model described in OET Bulletin No. 72 ("OET 72").[112] Furthermore, Congress intended for the Commission to base its recommended predictive methodology on the ILLR model.[113]

It would be appropriate for the Commission to recommend the ILLR model for digital signal prediction purposes—with one exception. The ILLR model as currently structured in OET 72 over-provides for clutter at UHF frequencies, and, in the digital context, these UHF clutter loss values make the model less accurate, rather than more accurate.[114]

Predictive models such as Longley-Rice already account for clutter factors such as buildings and vegetation inasmuch as they are empirically-based. As the Longley-Rice Manual explains, the model combines certain theoretical treatments

> using empirical relations derived as fits to measured data. This combination of elementary theory with experimental data makes it a *semi-empirical* model . . . .
>
> *The data used in developing the empirical relations have clearly influenced the model itself.* It should then be noted that these data were obtained from measurements made with fairly clear foregrounds at both terminals. In general, ground cover was sparse, but some of the measurements were made in areas with moderate forestation. *The model, therefore, includes effects of foliage, but only to the fixed degree that they were present in the data used.*[115]

The fact that Longley-Rice is semi-empirical and incorporates the then-existing clutter in the model

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[112] OET Bulletin No. 72, *The ILLR Computer Program* (July 2, 2002).

[113] *See* H.R. REP. NO. 108-634, at 20 (2004) ("The Committee intends the FCC to base its methodology on the FCC's existing technical specifications for digital television service and the individual location Longley-Rice algorithm.").

[114] *See* Cohen Engineering Statement at 5-6.

[115] G.A. Hufford *et al.*, *A Guide to the Use of the ITS Irregular Terrain Model in the Area Prediction Mode*, NTIA Report 82-100 (U.S. Dep't of Commerce Apr. 1982) ("Longley-Rice Manual"), at 12 (emphases added); *see also id.* at 22.

is well-recognized in the scientific and technical community.[116]

In creating the ILLR model, the Commission was careful to include additional clutter, above and beyond that already accounted for in the semi-empirical model itself, only where it made the model more accurate. Thus, the Commission determined that any clutter loss values greater than 0 dB would make the model less accurate in the low VHF and high VHF bands for analog signal predictions. With respect to the analog UHF band, the Commission proposed modest clutter loss values for certain land use categories (between 3 dB and 6 dB for the lower half of the UHF band and between 5 dB and 8 dB in the upper half of the UHF band). The Commission determined that these UHF clutter factors, when analyzed with real-world data for over-predictions and under-predictions, made the model the most accurate.[117]

In the case of digital signal predictions, the clutter considerations already inherent in the basic Longley-Rice model provide a more accurate predictive model than the additional UHF clutter loss values added into the ILLR model in OET 72. The National Association of Broadcasters ("NAB") is providing extensive data (more than 2000 individual site predictions with associated measured

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[116] *See, e.g.*, R. Grosskopf, *Comparison of Different Methods for the Prediction of the Field Strength in the VHF Range*, 35 IEEE TRANS. ON ANTENNAS & PROPAGATION 852 (July 1987), 852 (stating that in the Longley-Rice model "empirically gained quantities influence the field strength prediction"); M.L. Meeks, *VHF Propagation over Hilly, Forested Terrain*, 31 IEEE TRANS. ON ANTENNAS & PROPAGATION 483 (May 1983), 488 (recognizing the semi-empirical nature of the Longley-Rice model and the fact that if affects the model's prediction of propagation loss); M.M. Weiner, *Use of the Longley-Rice and Johnson-Gierhart Tropospheric Radio Propagation Programs: 0.02-20 GHz*, 4 IEEE J. ON SELECTED AREAS IN COMMUNICATIONS 297 (Mar. 1986), 297 (stating that Longley-Rice is a "statistical/semi-empirical model[] of tropospheric radio propagation"); *id.* at 299 (stating that it is necessary to take account of vegetation only in the immediate vicinity of the receiving antenna because "knife-edge diffraction by vegetation distant from the antennas is usually included in the semi-empirical methods used for estimating the excess propagation loss").

[117] *See Establishment of an Improved Model for Predicting the Broadcast Television Field Strength Received at Individual Locations*, First Report and Order, 15 FCC Rcd 12118 (2000), at ¶¶ 13-15 & Appendix A, Table 3.

field strengths) in its comments in this proceeding providing empirical support for this new modification to the ILLR model. NAB shows, using the same basic form of analysis that the Commission undertook in creating the ILLR model, that the best balance of over-predictions and under-predictions—and, hence, the most accurate predictive model—is provided by the Longley-Rice model without the OET 72 UHF clutter loss values.

In sum, Network Affiliates urge the Commission to recommend to Congress that it prescribe the Longley-Rice predictive model, without the OET 72 UHF clutter loss values, for use after the digital transition is complete in presumptively determining whether an individual location can receive a digital signal of the requisite threshold intensity.

Conclusion

For the foregoing reasons, Network Affiliates respectfully request that the Commission recommend to Congress (1) that the digital signal strength thresholds set forth in Section 73.622(e)(1) remain the same for purposes of determining whether a household is "unserved" by a digital signal pursuant to 17 U.S.C. § 119(d)(10); (2) that the testing methodology set forth in Section 73.686(d) be modified slightly, as explained herein, so that the procedure may be used for digital signal site tests; and (3) that Congress prescribe a slightly modified ILLR model, as explained herein, to be used after the digital television transition is complete to presumptively determine the eligibility of a household to receive a duplicating distant digital network signal.

Respectfully submitted,

ABC, CBS, AND NBC
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June 17, 2005

Appendix

Engineering Statement of Jules Cohen, P.E.

JULES COHEN, P.E.
Consulting Engineer

ENGINEERING STATEMENT IN SUPPORT OF COMMENTS
FCC NOTICE OF INQUIRY, ET DOCKET NO. 05-182

This engineering statement, prepared on behalf of Network Affiliates, is in support of comments responding to the Commission's Notice of Inquiry In the Matter of Technical Standards for Determining Eligibility For Satellite-Delivered Network Signals Pursuant To the Satellite Home Viewer Extension and Reauthorization Act, ET Docket No. 05-182, released May 3, 2005. The statement is directed, particularly, to the equipment employed to intercept the desired digital signal and the effect of that equipment on Planning Factors. Included also are comments on field testing of the availability of an adequate digital signal from a local terrestrial television broadcast station.

As a threshold matter, the criteria employed to determine eligibility for satellite-delivery of network signals should include an assumption that the receiving point apparatus includes equipment appropriate for the location of the household. Generally, that implies that distant locations use outdoor antennas of reasonably high gain, preferably supplemented by a mast-mounted low noise amplifier. Although at distances relatively close to the transmitter site indoor antennas may suffice for a satisfactory viewing experience, some locations may be so obstructed by terrain, either natural or man-made, that they require equipment generally considered necessary only for distant locations. Additionally, in each instance, the antenna should be assumed to be oriented toward the strongest signal arriving from the desired station. At times, that strongest signal may not be on the direct bearing to the transmitting station but may be from a